CBCT-3D Anthropometric Measurement of Mandibular Bone to Sex Determination in Surabaya Indonesia : a Pilot Study

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Abstract

Background : Identification of personal is one of important aspects in forensic odontology, because it is one of the core aspect of forensic science. The one methode of sex determination is measurement of mandibular. The mandibular is a largest and most powerful facial bone in the skull, which is generally resistant to postmortem damage and an important source for personal identification. Previous studies have studied gender and age prediction using CBCT reconstructive images in a different picture.The objective of this study is to determine the sex determination of os.mandibular using CBCT anthropometric measurements.

Materials and Methods : This study involved twenty subjects (10 male and 10 female) with age group between 20 and 35 years. CBCT scans were performed on all subjects, and the data obtained is reconstructed for 3D viewing. After getting a 3D CBCT scan, measurements were taken on six parameters.

Results : The differential mean of male and female is 1,7 mm (Ramus-L), 2,1 mm (Con-Cor), 6,9 mm (BG-Br), 7,3 mm (BIC-Br), 3,5 mm (BH 1st molar) dan 3,8 mm (BH canine). The collected data were analyzed using SPSS statistical with Independent T-Test and Logistic Regression test and also Discrimant Function. The results showed that of the six parameters, BG-Br and BIC-Br showed 0,0 ($P<0,05$) statistically significant differences, with the accuracy of the prediction of gender determination on BIC-Br 70% for male and 80% for female and the overall BG-Br yield of 80% to both group.

Conclusion : Sex determination using mandibular with 3D imaging methods can be used and helps in sex determination with 80% accuracy.

Keywords: *Sex Determination, Mandible, CBCT-3D, Forensic Odontology*

Introduction

Many methods of forensic identification can be used for the purpose of determining a person's identity.[1] In forensic field, identity defines as the group of the unique characteristic. In other hand, identification means comparing the different detail of each individual and finding the similarities based on the previous database.[2]

Sex determination is one of main necessities that used to identify missing person or in unknown condition.[3,4] The difference of morphological result has been reported in many studies, by using skeletal features in the desired target population. The skull has preferred shape, with a very dense condition and it is almost indestructible, it becomes the basic characteristic of determining sex that is accurate to 92%.[1,2] Thus, the part of skull such as mandible can have high diagnostic

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value.[5] The mandible itself is a large and very strong bone from the skull, therefore it is used for analysis. Basically, men bones are bigger and strong than women, because the shape, strength and angulation of the masticatory muscles affect the expression of mandibular dimorphism, because the degree of use of these muscles varies in men and women.[2]

Identification in forensic odontology, CBCT can be used in many methods of estimating dental age, which are the key elements of forensic science. CBCT has been established as a non-invasive method for estimating a person's age.[6] Cone Beam Computed Tomography (CBCT) can be used in cases that require proper visualization in comparing the conditions of ante-mortem and post-mortem odontograms, especially in the identification of victims of corpses with severe damage so that fast identification is needed.[3,7]

Mandibular osteometry measurements on computed tomography (CT) to estimate the sex of specific populations. The measurement involves the longest formula, gonial angle, mandibular base length, and shorter mandible branches.[8] Measurements made in a sagital view are reconstructed in three dimensions, and the distance between gonial and between the condyle is measured in a three-dimensional axial view (3D).[9]

Based on these various literature, the research about sex determination using anthropometric measurements on mandibular bone using CBCT-3D scan which includes ramus length, condyle to coronoid, canine body height, 1st molar body height, bi-gonial breadth and bi-gonial breadth condylar breadth.

Material and Methods

Sample

The sample came from 20 subjects (10 male and 10 female) with age group between 20 and 35 years, after get treatment of CBCT scan in July - August 2019, Pramita Clinical Laboratory Surabaya. Criteria sample consisted of inclusion criteria in which CBCT images of the mandible scan looked good, no missing teeth, there were no blurred or cutting on the mandible fragment, and there were no pathological abnormalities. CBCT image captured with the Auge Solio brand CBCT tool at Pramita Clinical Laboratory.

Measurement

Two observers from oral and maxillofacial radiologist (They from Faculty of Dental Medicine, Univeristas Airlangga, Surabaya) and measured six parameters aspect to identification of mandible. These measurements used 3D imaging (On Demand 3D application software).

Six paramater to mandibular anthropometric measurements used:

a) RL (Ramus Length): the distance between from the anterior point of mandible ramus and the line connecting the most posterior point of condyle and jaw angle.

b) Con - Cor (Condyle to Coronoid): the posterior distance from condyle to anterior from coronoid.

c) BH 1st molar (Body Height of first molar): the distance from the base of mandibular bone to mesial molar cups.

d) BH canine (Body Height of canine): the distance from the base of mandibular bone to canine cups.

e) BIC-Br (Bilateral condylar breadth): the straight distance between left and right condyle of mandible.

f) BG-Br (Bilateral gonial breadth): the straight distance between two gonial (go) left and right, posteroinferior angle between the ramus and the surface of mandible.

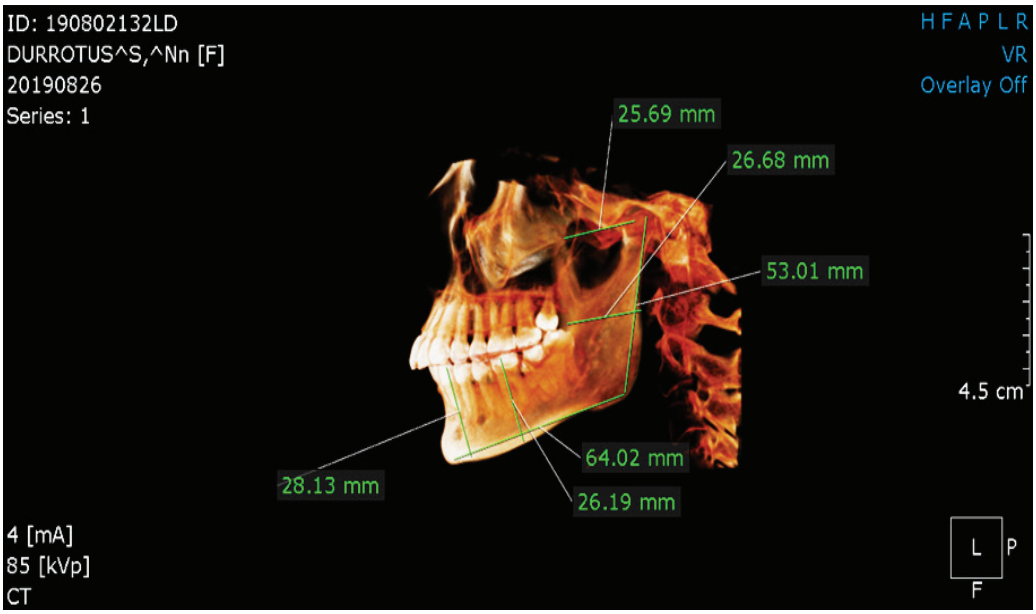

Fig 1. Sagital view of mandibular measurement.

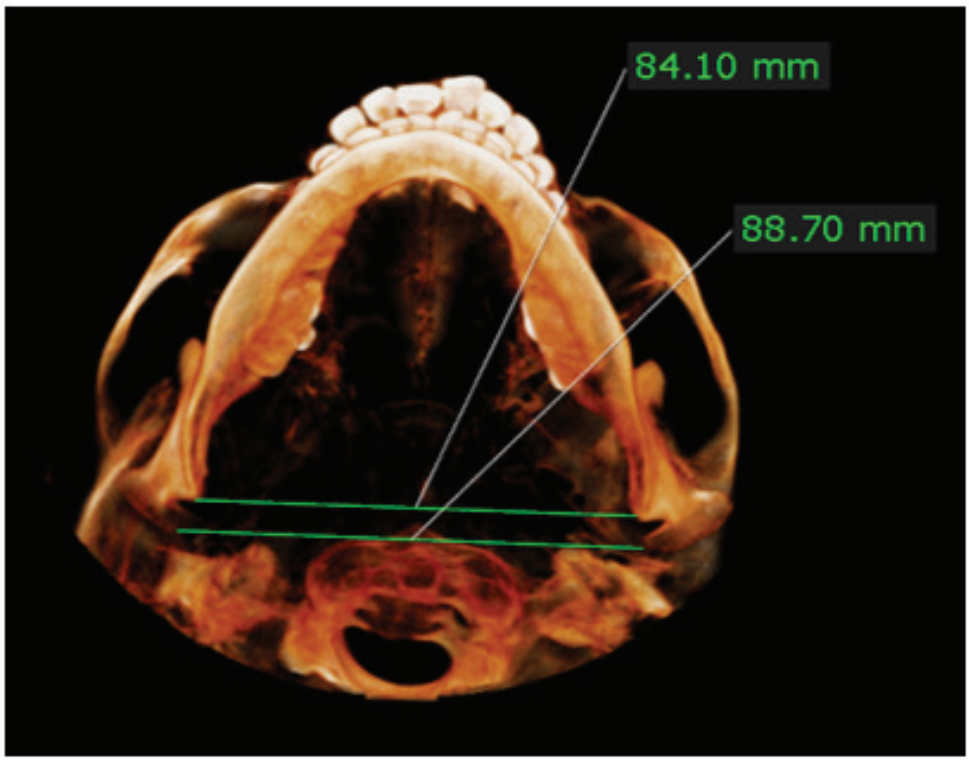

Fig 2. Axial view to BIC-Br and BG-Br measurement.

Statistical Analysis

Collected data were analyzed using the SPSS statistical analysis program vers. 20 (IBM Corporation, New York, U.S.) by Student's independen *t*-test, logistic Regression test and discriminant function analysis with the stepwise feature was used to choose the most discriminatory variable.

Results

Table 1. The mean value±standard deviation of the six mandibular measurements compared between males and females using the student's independent *t*-test

Parameter	Sex	N	Mean	SD	P	Sig.
Condyle to coronoid	M	10	33,1	2,8	0,2	NS
	F	10	31,0	3,7		
Ramus Length	M	10	31,4	2,9	0,2	NS
	F	10	29,7	3,0		
Bh 1stmolar	M	10	31,9	4,8	0,1	NS
	F	10	28,4	2,1		
Bh canine	M	10	33,5	5,5	0,1	NS
	F	10	29,7	3,0		
Bi condylar breadth	M	10	99,0	4,7	0,0	S
	F	10	91,7	5,1		
Bi gonial breadth	M	10	93,2	5,8	0,0	S
	F	10	86,3	4,2		

Note significant p < 0,05

The descriptive analysis of the mandibular parameters in both genders are shown in Table 1. The quantitative data is calculated as Numbers (N), Mean, Median Standard Deviation (SD) and P value. The mean calculated shows that the dimension of all parament from male more than female. The differential mean of male and female is 1,7 mm (Ramus-L), 2,1 mm (Con-Cor), 6,9 mm (BG-Br), 7,3 mm (BIC-Br), 3,5 mm (BH 1st molar) dan 3,8 mm (BH canine). Significant differences were observed only among all the two parameters of the BIC-BR and BG-Br (p value <0.05) using independent t test.

Table 2. Prediction Binary Logistic Regression of Bicondylar Breadth

			Prediction		
			Sex		Percentage (%)
			M	F	
Step1	Sex	M	7	3	70
		F	2	8	80
	Total				75

Table 3. Prediction Binary Logistic Regression of Bigonial Breadth

			Prediction		
			Sex		Percentage (%)
			M	F	
Step1	Sex	M	8	2	80
		F	2	8	80
	Total				80

The accuracy of sex determination use BIC-Br and also BG-Br parameter by binary logistic regression is 75% and 80%, with the false prediction to male and female is 25% to BIC-Br and 20% to BG-Br showed on table 3 and 4. But different accuration by discriminant function analysis that the overall result is 80% to sex determinant on table 5.

Table 4. Linier Function of discriminant analysis

	Function
	1
Bicondylar	0,202
Bigonial	0,425
(constan)	-19,286

This Linier function of discriminant anaylsis on table 4. were following a formulation :

$Y = Bo + B1. X1 + B2. X2$

Y = -19,286 + 0,202 Bicondylar + 0,425 Bigonial

The formula can be used to prediction gender male or female. If the result of calculation of formula is negative, or $p < 0,05$ is mean more like to male prediction.

Table 5. Overall prediction accuracy 80%

sex	original subject	prediction of sex through CT	accuracy	
			true positive	false positive
M	10	7	80%	70%
F	10	8	80%	80%

Discussion

Sex determination is very important for identification in forensic medicine, medico legal cases and forensic anthropologists.[10] Sex determination is reliable in cases where an intact body is available.[11] The same is difficult when only part of the body is found. It is often difficult for forensic anthropologists when only facial photographs or head or facial remains are brought

for examinations because the standards available and the accessibility in this direction are very less. Hence facial measurements are useful in the absence of other evidence for sex estimation.[12,15]

Kharoshah et al (2010) conducted a study for analysing the sexual dimorphism in mandible by 3D-CT in 2010 by taking the different mandibular parameters in this study and concluded that BIC-Br, G-angle, and minimal Ramus-L have significant sexual dimorphism with overall accuracy of 83.9%, however, their study showed significant statistical difference with the G-angle, Ramus-L, G–G-L, BIC-Br, and CO-L ($P < 0.05$) with overall accuracy of 84%.[8,14]

Dayal et al (2008) reported the assessment of sex using 120 skulls, using 6 mandibular measurements, and the application of discriminant function analysis and had an average accuracy of 85%. The study concludes that the stepwise feature discriminant analysis could identify the gonial angle and ramus length, gonion–gnathion length and bigonial breadth as final predictors of sex determination with overall predictive accuracy of 83.2% as the best predictor of sex dimorphism.[13]

El-fatauh et al (2018) reported about his studies added three measurements of the mandibular analysis like a (BH canine, BH 1st molar, and distance from Condyle to coronoid) for new entity in response to the fact that there is a difference between males and females in musculature. That would reflect on the degree of skeletal growth and development in a way that allowed us to markedly differentiate between sexes with result accuration is 85,8%.[2]

In my present studies, following combination of mandibular measurement from kharoshah and El-Fatauh and only use 6 parameter of mandibular like a Condyle to coronoid, ramus lenght, bh 1st molar, bh canine, BIC-Br and BG-Br by statistic application of logistic regression analysis and discriminant function analysis, showed the significant parameter in BIC-Br and BIG-Br. The results is 75% and 80%, but for overall predictive accuracy by discriminant function is 80% to sex determination. It's mean the accuracy analysis both of them have similar result, although had 5% different.

Many authors have studied the metrical traits of the mandible and their reliability in sex determination, with accuracy results varying from 60 to 90%.[15] Most of the authors have measured up to 5-7 variables, and the studies that focus on less than 5 parameters have an accuracy of sex determination of about 80%.[11,12]

Conclusion

In this studies showed that all parameter can be performed to sex determination using any parameter from mandibular . The CBCT scan is good methods to analysing many condition of human skull. Any suggest to the next research is may can using different part of mandibular like a forament or combination and also another statistic analysis.

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Conflict of Interest : Nil

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